закаленных низкоуглеродистых сталей обусловлено происходящим при этом переходом от структур с одноосной магнитной анизотропией к структурам с тремя осями легкого намагничивания. В модели преобладающих 180-градусных смещений для этих магнитных структур получены численные оценки величин M_{Hc} и M^{+Hc}, которые достаточно хорошо согласуются с экспериментом. Показана возможность локального измерения предлагаемого параметра M^{+Hc} (или соответствующей индукции B^{+Hc}) с помощью мобильной аппаратно-программной системы DIUS-1.15M.

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1. http://www.magnet-physik.de
2. Костин К.В., Костин В.Н., Смородинский Я.Г. Дефектоскопия, 2, 3(2011).
3. Костин В.Н., Василенко О.Н. Дефектоскопия, 7, 3(2012).
4. Костин В.Н., Василенко О.Н., Бызов А.В. Дефектоскопия, 9, 37(2018).

DOMAIN PATTERNING IN CONGRUENT LITHIUM NIOBATE BY ELECTRON BEAM IRRADIATION AT ELEVATED TEMPERATURES

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Annotation. The domain formation induced by electron beam irradiation in congruent lithium niobate crystals has been studied in wide temperature range. The obtained results can be used for development of the domain engineering methods to create nonlinear optical crystals with improved characteristics.

We have studied the domain formation by electron beam (e-beam) irradiation in congruent lithium niobate crystals (CLN) covered by artificial surface dielectric layer at room and elevated temperatures. The obtained results were explained in terms of kinetic approach based on the analogy of domain growth with the first order phase transitions [1].

The samples represented the 0.5-mm-thick Z-cut CLN plates. The irradiated Z- polar surface was covered by 2.5-μm-thick AZ nLOF 2020 (Microchemicals) resist layer, the opposite one – by copper electrode grounded during irradiation. The domain structures have been produced by controllable e-beam irradiation at room and elevated temperatures using scanning electron microscopes Auriga Crossbeam Workstation (Carl Zeiss) attached by Elphy Multibeam (Raith) e-beam lithography system and Merlin (Carl Zeiss) equipped with Gatan heating/cooling stage.

The dose and temperature dependences of the shape and sizes of isolated domains were measured after dot irradiation. It was shown that a hexagonal domain shape appeared at room temperature whereas the heating led to the formation of self-assembled domain structures. The revealed effects were attributed to the transition from conventional switching by means of determined nucleation to discrete switching by correlated nucleation due to highly non-equilibrium switching conditions caused by changing of chemical and electrical properties of artificial dielectric layer at elevated temperatures. We have shown that the resist hard bake drastically changes the domain shape in the whole temperature range. Formation of the circular domains during dot irradiation allowed creating of the domains with arbitrary shape.

Four types of domain structures appeared as a result of stripe irradiation at room temperature have distinguished: (1) isolated nanodomains; (2) isolated domain rays oriented along Y+ directions; (3) solid domains with jagged walls (“fish-bone” structure); (4) continuous solid stripe domains. The obtained domain patterns have been considered as subsequent stages of the domain structure evolution [2]. The threshold dose of solid stripe domain formation has been revealed. The temperature dependence of the stripe domain shape was revealed and discussed as well.

The evolution of the non-through domain structures was reconstructed using series of images obtained at the different depths in the crystal bulk by confocal Raman microscopy and Cherenkov-type second harmonic generation microscopy. The main stages of the domain growth were revealed according to the principle “the deeper - the earlier” [3]. It was shown that the obtained stages correlate with the stages revealed at various doses on Z- polar surface.

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1. Shur V.Ya., J. Mater. Sci., 41, 199 (2006).
2. Vlasov E.O., Chezganov D.S. et al., Scanning, 2018, 7809826 (2018).
3. Shur V.Ya., Zelenovskiy P.S. et al., J. Appl. Phys., 110, 052013 (2011).